## **CLAIMS**

1	1.	A vehicle with a lean and alignment control system, comprising:	
2		a frame having a central longitudinal axis and an upright axis that is adapted to be	
3	genera	ally perpendicular to a surface on which the vehicle rests when the frame is in a	
4	neutra	l position with no net leaning loads applied;	
5		a suspension comprising a plurality of arm assemblies connected to the frame;	
6		a mechanical feedback mechanism forming an interconnection between the frame	
7	and th	and the suspension;	
8		wherein each arm assembly comprises:	
9		a lower arm having an inboard end and an outboard end;	
0		an upper control arm having an inboard end and an outboard end; and	
1		an actuator mounted to the lower arm and motively connected to the upper	
12	contro	ol arm.	
1	2.	The vehicle of claim 1, wherein the actuator further comprises:	
2		an actuator arm pivotally connected to the inboard end of the upper control arm;	
3		the actuator arm pivotally connected to the inboard end of the lower arm; and	
4		a mechanical drive mechanism motively connected to the actuator arm to move	
5	the actuator arm through a range of motion.		
1	3.	The vehicle of claim 2, wherein the mechanical feedback mechanism comprises a	
2	position indicating cam operably associated with the arm assembly for automatically		
3	contro	olling the mechanical drive mechanism and the actuator arm.	
1	4.	The vehicle of claim 3, wherein:	
2		the position indicating cam comprises an eccentric fixed to rotate with the lower	
3	arm; and		
4		the mechanical drive mechanism comprises an actuation cylinder mounted to the	
5	frame and receiving an input from the eccentric as the lower arm moves.		

- 1 5. The vehicle of claim 4, wherein the mechanical drive mechanism further
- 2 comprises:
- the actuation cylinder in fluid communication with a fluid driven rack and pinion;
- 4 and
- a fluid driven rack and pinion drivingly connected to the actuator.
- 1 6. The vehicle of claim 5, wherein the mechanical drive mechanism further
- 2 comprises:
- the actuation cylinder fluidly connected to the fluid driven rack and pinion by a
- 4 high pressure fluid line containing a substantially noncompressible fluid; and
- a fluid reservoir in the high pressure fluid line for receiving excess fluid during
- 6 periods of high flow rate.
- The vehicle of claim 6, wherein the reservoir is an expansible reservoir having an
- 2 adjustable spring for adjusting an expansibility of the reservoir.
- 1 8. The vehicle of claim 5, wherein the mechanical drive mechanism further
- 2 comprises:
- the actuation cylinder fluidly connected to the fluid driven rack and pinion by a
- 4 high pressure fluid line containing a substantially noncompressible fluid; and
- a pressure control valve in the high pressure fluid line for adjusting a flow
- 6 aperture through which the fluid flows.
- 1 9. The vehicle of claim 8, wherein the pressure control valve comprises a needle
- 2 valve for adjusting the flow aperture and a pop off valve for releasing the fluid at
- 3 pressures greater than a predetermined threshold.

- 1 10. The vehicle of claim 5, wherein the mechanical drive mechanism further
- 2 comprises:
- the actuation cylinder fluidly connected to a first side of the fluid driven rack and
- 4 pinion by a high pressure fluid line;
- 5 the actuation cylinder fluidly connected to a second side of the fluid driven rack
- 6 and pinion by a low pressure fluid line.
- 1 11. The vehicle of claim 2, wherein:
- the arm assembly is a first arm assembly, the vehicle further comprising a
- 3 plurality of similar arm assemblies including the first arm assembly;
- 4 the mechanical feedback mechanism is a first mechanical feedback mechanism,
- 5 the vehicle further comprising a plurality of similar feedback mechanisms operatively
- 6 associated with respective arm assemblies; and
- 7 each mechanical feedback mechanism comprises a position indicating cam
- 8 operably associated with the respective arm assemblies for automatically controlling the
- 9 mechanical drive mechanism and the actuator arm in each arm assembly.
- 1 12. The vehicle of claim 11, wherein the plurality of arm assemblies comprises:
- at least a first arm assembly on a first side of the frame;
- at least a second arm assembly on a second side opposite to the first side; and
- 4 wherein the mechanical feedback mechanisms automatically move the first arm
- 5 assembly through a first lean angle closer to the frame and the second arm assembly away
- 6 from the frame so that the first and second arm assemblies remain generally parallel to
- 7 each other in response to a leaning force applied by a rider of the vehicle.

- 1 13. The vehicle of claim 11, further comprising:
- at least one speed sensor operably associated with the vehicle and adapted for
- 3 detecting the vehicle speed;
- a mechanism for automatically adjusting an expansibility in a fluid reservoir based
- on the vehicle speed; and
- 6 wherein the mechanical feedback mechanisms control the fluid driven rack and
- 7 pinions in each arm assembly and move the actuator arms to provide a smooth lean of the
- 8 frame relative to the arm assemblies.
- 1 14. The vehicle of claim 2, further comprising:
- a shock absorber having an inboard end and an outboard end;
- 3 the inboard end of the shock absorber connected to the frame; and
- 4 the outboard end of the shock absorber connected to the actuator arm.
- 1 15. The vehicle of claim 14, wherein the shock absorber is connected to the actuator
- 2 arm outboard relative to a position at which the upper control arm is connected to the
- 3 actuator arm.
- 1 16. The vehicle of claim 14, wherein the shock absorber moves in a range of motion
- 2 between:
- a first position in which the shock absorber extends in an end to end direction
- substantially parallel with the lower arm of a first arm assembly of the plurality of arm
- s assemblies when the frame is leaned away from the first arm assembly; and
- a second position having an angle of approximately forty-five degrees relative to
- the lower arm of the first arm assembly when the frame is leaned toward the first arm
- 8 assembly.
- 1 17. The suspension of claim 14, wherein the outboard end of the shock absorber
- 2 moves in a range of motion between a position generally above the upper control arm to a
- 3 position generally below the upper control arm.

- 1 18. The vehicle of claim 2, wherein the actuator arm comprises:
- a first connection comprising structure that pivotally connects the actuator arm to
- 3 the lower arm;
- a second connection comprising structure that pivotally connects the actuator arm
- 5 to the upper control arm;
- a third connection that connects a shock absorber to the actuator arm; and
- wherein a line through the first connection and the second connection is at an
- angle in a range substantially from 0 to 90 degrees relative to a line through the first
- 9 connection and the third connection.
- 1 19. The vehicle of claim 18, wherein the angle is approximately forty-five degrees.
- 1 20. The vehicle of claim 18, wherein the third connection is outboard of the second
- 2 connection.
- 1 21. In a vehicle, a method of tracking a contour of a driving surface to absorb shock,
- 2 the method comprising:
- automatically and independently raising and lowering a plurality of arms of the
- 4 vehicle suspension to accommodate variations in the contour by a mechanical
- 5 mechanism;
- 6 providing feed forward by at least one mechanical shock absorber;
- 7 providing feedback via the mechanical mechanism to an actuator; and
- 8 raising and lowering the arms by the actuator according to the feedback.
- 1 22. The method of claim 21, wherein the mechanical mechanism comprises a position
- 2 indicating cam fixedly supported relative to at least one of the arms, and wherein the step
- of providing feedback further comprises feeding back a representation of a position of the
- 4 at least one of the arms by way of the cam.

- 23. The method of claim 21, comprising providing additional feed forward by taking
- 2 up excess fluid in an expansible reservoir in fluid communication with the
- 3 mechanical mechanism.

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